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ABSTRACT

Research libraries are taking on a range of new roles in the digital age as they become more deeply engaged in the creation and dissemination of knowledge. While some of these roles are extensions of traditional library activity, others are large new. This book explores some of these emerging functions, and includes several examples of how more libraries and library organizations are forging new services in areas of collection development, information access, and user services. The book also touches briefly on the continued importance of library as place, and it suggests where new roles might emerge. The book is divided into three main sections. The first, The Evolution of Library Roles discusses three phases: (1) The Growth of Distributed Technologies; (2) The Development of Open Paradigms and Models; and (3) The Emergence of the Library as a Diffuse Agent. The second section, Library Roles in a Digital Age, discusses collection development, information access, user services, and the library as place. The third section, Realizing Diffuse Roles for Libraries, deals with tangible and intangible investments. (Contains 39 references.) (AEF)

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Diffuse Libraries: Emergent Roles for the Research Library in the Digital Age

Wendy Pradt Lougee

August 2002

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PERSPECTIVES ON THE EVOLVING LIBRARY

Diffuse Libraries: Emergent Roles for the Research Library in the Digital Age

by Wendy Pradt Lougee

August 2002

Council on Library and Information Resources
Washington, D.C.

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Preface

Wendy Lougee is a pioneer in the digital library world. While at the University of Michigan, she was instrumental in defining and shaping what we have come to call the digital library. She was among the primary movers at the Digital Library Federation (DLF) as well, and it was at her insistence that DLF member libraries did not lose sight of the importance of the word "Federation" in the group's name. Ms. Lougee recognized, even in the early stages of DLF, that while digital technology was dramatically changing the roles of libraries, progress could be made only when a library's contributions advanced the institutional, as well as the collective, agenda.

In several recent essays and reports, the Council on Library and Information Resources has explored the role of the library in the digital world. For example, we have considered questions about the nature of collections when libraries license rather than purchase content. What are the implications for long-term preservation? We have also asked questions about the importance of library space when readers can retrieve information from their desktops and no longer have to visit the library. How does the role of the librarian change in such an environment?

In the digital world, libraries are becoming more involved in the creation and dissemination of knowledge. Ms. Lougee asserts that this is changing the very nature of the library. She offers examples of the new roles that a few libraries have taken on. She notes that some of these roles are extensions of traditional library activity, but also notes that wholly new functions and opportunities are emerging. Collaboration with new and diverse partners has become more important than ever; however, building effective collaborative relationships require far more than simply finding organizations that are willing to help the library do its work.

Notwithstanding the evolution of library roles, Ms. Lougee aptly notes that the library retains a distinct identity that holds special meaning for members of the academic community.

Deanna B. Marcum
President, CLIR

Introduction

The past two decades have been a time of tremendous social, economic, and institutional change for all sectors of higher education, including the research library community. While responding to the unprecedented development of technology, colleges and universities have also addressed issues of social relevance, accountability, diversity, and globalization. Although academic institutions are notoriously slow to change, they have experienced considerable ferment, prompting shifts in priorities and constituencies and within disciplines.

Because research libraries support all sectors of academic life, they reflect a context where these issues converge. This presents them with a challenge of unusual scale and complexity. In response, libraries have embraced new technologies and adjusted to the program priorities of their parent institutions. As the so-called information revolution has taken shape, libraries have also demonstrated broader leadership in bringing their intellectual and service missions to bear on the issues raised.

However, libraries face significant challenges in responding to change while sustaining their traditional functions. With the explosion of information technology have come powerful competitive forces that raise fundamental questions about the role of libraries and librarians. Have the capabilities of the Internet and new information services—everything from Ask Jeeves to Amazon.com—given rise to credible competitors? Are libraries at risk of becoming irrelevant, or is the librarian's expertise more critical than ever? Can the basic functions of libraries be maintained in a distributed information environment, or will totally new functions emerge?

The thesis explored in this paper is that the changes under way reflect an evolutionary path in which, as distributed and collaborative models emerge, libraries are taking on far more *diffuse* roles within the campus community and beyond. That is, libraries are becoming more deeply engaged in the creation and dissemination of knowledge and are becoming essential collaborators with the other stakeholders in these activities.

The roles emerging through this evolution are based in part on extrapolations of existing functions, yet they also represent fundamentally new roles for academic libraries. We see these changes reflected in the library's shift from:

- emphasizing the value of collections to emphasizing the value of expertise
- supporting information description and access to taking responsibility for greater information analysis
- serving as a support agency to serving as a collaborator
- a facility-based enterprise to a campus-wide enterprise

This analysis of library roles covers the 10 to 15 years in which distributed computing, the Internet, and the World Wide Web took hold. The environment that nurtured and catalyzed library activities was influenced by myriad forces, both technical and nontechnical; however several overriding themes merit attention. These themes reflect a developmental path for the evolving roles of libraries in the digital age. This path can be described in three phases: the growth of distributed technologies, the development of open paradigms and models, and the emergence of the library as a diffuse agent.

The Evolution of Library Roles

Phase 1: The Growth of Distributed Technologies

In the 1990s, distributed computing and the Web democratized technology by bringing it to the desktop. As a result, many individuals and institutions now have the basic capabilities for publishing and creating "libraries." This has prompted an explosion of information goods and services for both the general and scholarly markets. For libraries, it has created both potential competitors and potential partners.

Two areas of technology development have contributed significantly to shaping the opportunities for libraries: the emergence of content standards and the maturation of more intelligent systems. These developments have progressed as the distributed environment has taken shape and continue to enable new capabilities for libraries.

Emergence of standards. The evolution of standards for creating, structuring, and disseminating digital content has allowed libraries and other content-rich organizations to move away from the proprietary methods of information access and management that characterized the early days of electronic information. As libraries gained experience with new modes of delivering content and the new genre of digital collections, these standards were embraced and integrated into library operations. Distributed computing introduced a panoply of players in the information arena; consequently, the emergence of these standards was a critical step toward achieving a more unified information environment and interoperability among distributed collections and content providers. These standards have offered

libraries new opportunities for handling content (e.g., to add functionality, deliver content differently for different audiences, or to sustain digital collections over time) and for enhancing the library's classic roles in information access and preservation.

Maturation of tools and systems. Intelligent tools and systems allow invisible mediation between content and user. They facilitate forms of information inquiry and analysis that were heretofore impossible. These developments could lead to the perception that libraries have become irrelevant, since system capabilities can assume mediation functions previously provided by libraries, often with human involvement. However, libraries can harness these capabilities to build far more robust and useful information environments. The challenge is to make resources seamless without making the library's role invisible.

In phase 1, we see libraries coming to terms with distributed tools and systems and beginning to incorporate these distributed resources into existing functions. Efforts to lay the groundwork needed to develop relationships among the new stakeholders are evident, as are subtle shifts in the traditional stewardship functions of libraries.

Phase 2: The Development of Open Paradigms and Models

At the start of the twenty-first century, we see evidence of several movements based on "open" paradigms. For example, the Open Source movement—the concept of software development wherein the source code is shared and development is collaborative—reflects a fundamental shift away from proprietary software and systems. These open models are appearing in an interesting array of new applications and venues, such as the Open Knowledge Initiative to share learning technologies and the OpenLaw program as a collaborative approach to crafting legal arguments. This trend toward open models may presage more generalized acceptance of collaborative development and sharing of intellectual goods and services. Cyberlaw expert Lawrence Lessig (2000) suggests that the creation of a "commons," wherein the free exchange of ideas and collaboration prevail, is fundamental to an open society. This belief stands in stark contrast to that of commercial and other interests, whose goal is to control the Internet and its content. One could argue that the notion of the commons also reflects a departure from models that embrace central control mechanisms—a model that has characterized library operations in the past.

Themes of openness and collaborative exchange have also emerged in the context of publishing, particularly with respect to the relationship between authors and commercial publishers. For example, the Open Archives Initiative (OAI) seeks to address concerns within the scholarly community about certain aspects of traditional journal publishing, especially the notion of a "gift economy," wherein intellectual property is ceded to the for-profit sector and then re-

purchased for community use. These concerns have given birth to new conventions, such as e-print archives, for distributing content.

As information becomes more distributed and open models of exchange become more common, the library's relationship with content creators, publishers, and consumers will change. There is in these open trends evidence of a shift from publication as *product* to publication as *process*. When content can be enhanced or supplemented over time by others, it becomes more dynamic and the "versions" become more cumulative. Some have forecast this shift as the ultimate challenge to current copyright law, which is based on objects fixed in time and space. Such a shift has significant impact on organizations whose current role is to manage publications in both traditional and new forms and to sustain the scholarly record for the future. As this shift continues, there are likely to be further changes in the library's information management functions and in its role as an agent in scholarly communication.

In this second phase in the evolution of library roles, the library starts to engage in collaboration as a strategy to address its core mission of building collections, maintaining access, and providing service. Building on distributed structures, the library begins to involve other stakeholders in fulfilling its functions, and sustaining relationships among stakeholders becomes an essential activity. As responsibilities for content and services become more distributed, models of central control give way to new mechanisms for coordination and collaboration. Ultimately, the processes of scholarly communication become as critical as traditional publication products.

Phase 3: The Emergence of the Library as a Diffuse Agent

As the evolution proceeds, libraries increasingly adopt distributed models for information access and management, and more often use open and collaborative models for developing library content and services. With the incorporation of distributed technologies and more open models, the library has the potential to become more involved at all stages, and in all contexts, of knowledge creation, dissemination, and use. Rather than being defined by its collections or the services that support them, the library can become a diffuse agent within the scholarly community.

What do we mean by "diffuse" roles or "diffuse libraries"? In physics, "diffusion" refers to the spreading out of elements, an intermingling (though not a combining) of molecules. Applying this analogy to libraries, we see the library becoming more deeply engaged in the fundamental mission of the academic institution—i.e., the creation and dissemination of knowledge—in ways that represent the library's contributions more broadly and that intertwine the library with the other stakeholders in these activities. The library becomes a collaborator within the academy, yet retains its distinct identity.

Library Roles in a Digital Age

As is often the case in times of change, organizational structures and the language for describing an organization's activities do not adequately reflect the transformations under way. Consequently, while the descriptions that follow derive from traditional functions of libraries (collection development, cataloging and access, user services, and place) these descriptions fall short in the contemporary context.

The sections that follow use selected examples to explore the dimensions of change in the classic roles of libraries. Are core functions and expertise being sustained? How have external forces left their mark? The cases include instances where traditional functions have been stretched and build on core activity, as well as instances where innovation reflects a significant break from past activity. The cases also reveal an evolution from models that capitalize on the distributed environment to models that are more open and diffuse.

Collection Development

Libraries have been in the collection business for centuries and are defined largely by the functions of collection development and management, that is, by a continuum of processes to select content appropriate for a particular community, make it accessible, manage it, and preserve it. These discrete functions have been viewed as necessary components of good collection stewardship, and they have obvious definition in a physical context. Libraries bought books (which they then owned), organized them, made them available through library facilities, and took steps to ensure the longevity of the volumes for future use.

To some extent, this full stewardship model is being followed in the digital arena. Libraries acquire and secure ownership of digital content (typically through license), store the content on local servers, and make it accessible to a target community. Libraries attempt, as protocols permit, to ensure long-term access to the digital collection through license conditions and through practices to create backup and redundancy, and to migrate the content over time. In a variation of the model, some libraries host commercial content or centrally manage content of other campus units. In both of these cases, the classic collection stewardship model is sustained largely intact. A defining characteristic of this traditional model is the library's ability to exercise primary responsibility for and control over the content and future access to that content.

Federation

Increasingly, the capabilities of the distributed environment prompt an unbundling of the discrete component functions of traditional collection development and management responsibilities. Models in which the library retains central control over content, its access, and its longevity may no longer be appropriate or sustainable. Consequently, we see instances of libraries providing access to electronic

content that they neither own nor manage. The library may also preserve and archive content that is not accessible to users.[1]

An interesting illustration of this unbundling of collection functions can be found in a model of *collection federation*. These efforts typically create structures with both decentralized and centralized responsibilities. Federated systems allow distributed content to be brought together and used as an integrated collection. Individual content managers retain ownership and governance over each discrete collection, but the content is made accessible under the principles of the larger federating system. The University of Michigan Library's Image Services provides a good example. This program offers mechanisms to integrate image content (e.g., photographs, art, or architecture) from independent providers and to represent it in a larger access system. The collection providers retain control, managing the individual image collections in a variety of different local database systems. Differing types of descriptive metadata are used for each collection, but each is converted to a standard encoding (using SGML or XML), and fields are mapped to minimal Dublin Core metadata in the federating system.

Image Services is optimized to provide access, without the overhead of a management system for the image collections themselves. Users can access each collection individually and exploit the full access protocols for each collection or search across all collections or a subset using the mapped, core metadata elements. User tools are also incorporated, allowing image analysis (e.g., pan and zoom) and comparison, subset creation, and presentation options within the federated system. Thus, the functional benefits of federation can be achieved without diminishing the features and specialized functionality of each independent collection.

Federation may seem to be a simple approach to bringing content together; however, the underlying design principles and intellectual effort involved suggest a far more complex role for the library. The difference from the full stewardship model is also significant. Whereas traditional models bring content control to the library and create a central access strategy, the federating model balances distributed content and collection-specific functionality with cross-collection functionality and tools. Figure 1 outlines the distribution of responsibilities that occurs in the federated model of Michigan's Image Services.

What is entailed in collection federation? First, content providers have to be identified for inclusion and evaluated by the federating agent (in this case, the library). Negotiation and education are often required to secure the participation of content providers. Contractual agreements may be necessary that specify the responsibilities of each party and the conditions for the use of the content. Each collection

[1] The Report of the Task Force on Archiving Digital Information (1996) suggested there might be instances where "fail-safe" archives could be created, i.e., where organizations take responsibility for archiving content at risk of loss. While access to the archive is the goal, it is possible that legal constraints might prohibit making the content immediately available.

DISTRIBUTION OF RESPONSIBILITIES IN COLLECTION FEDERATION

Distributed Collection Manager Responsibilities	*Library Federation Responsibilities*
Collection development and management	Content identification and agreements
Metadata development and maintenance	Metadata mapping and maintenance
Database development and management	Tool assessment and development
Rights management	Access system development and maintenance
Collection archiving	Rights protection
	Content provider relationships

Fig. 1. University of Michigan Image Services Federation

database structure must be analyzed and understood to map metadata schema. At the federating system level, user assessment and task analysis are needed to inform the design of the search system, and analytic tools must be incorporated. A system architecture needs to be developed to implement the search, display, and tool functions that draw on distributed content. Finally, federation requires ongoing assessment of system functionality and maintenance of the relationships with the content providers.

Organizationally, the service reflects a melding of expertise related to the subject domain, content characteristics, access, service, and technology. One could add to the list skills related to human-computer interaction, interface design, and usability assessment. Technology infrastructure is imperative, as are the "organizational infrastructure," (i.e., the server and software apparatus) and the "relationship apparatus" reflected in sustaining the federation partnership. Threaded throughout programs of this sort are often issues of intellectual property, licensing, and rights management. The organizational implications are significant. There are obvious investments required to build the technology components. Perhaps more critical than any financial investment, however, is organizational support for the coalescing of expertise within and outside of the library.

An additional implication of the federating model relates to the responsibility for documenting and preserving scholarly resources over time. In the federated model, the library controls neither the content nor the permanence of these resources. To the extent that component collection databases are dynamic and subject to decisions of the distributed collection managers, the library must forgo its traditional archiving role. However, this prompts a new responsibility for the library in influencing and educating individual content providers, the institution, and the community about the requirements for preservation and archiving of resources.

Library as Publisher

As a second example of new paradigms for the library's role in collection development, we see libraries becoming more engaged in the publishing process, including content presentation, management, and distribution policies and practices. This moves the library closer

to the point of creation and distribution in the publishing process and broadens its functions beyond archiving and mediation for published works.

There are several variations on the theme of library-as-publisher. In some instances (e.g., Stanford University's HighWire Press or Johns Hopkins University's Project MUSE), the focus has been on providing robust distribution services for established society and university presses. Other enterprises, such as the California Digital Library's e-Scholarship program, serve more as incubators, providing tools and services to facilitate innovation in publishing, particularly e-print or similar repositories. The content creators and producers are within the University of California system, where they may serve institutional interests as well. Finally, there are examples such as the Electronic Publishing Initiative at Columbia (EPIC), where the partner organizations exercise direct control over content, pricing, and distribution in a classic publishing model.

Although these three publisher/distributor examples differ in the degree of control over content (e.g., content evaluation and editorial control), they share some features. Each model engages the library directly in the processes of publishing. Consequently, there is an opportunity for libraries to advocate for responsible practices (e.g., on pricing, licensing, or archiving) as well as to develop new relationships with publishers.

The ideologies that inform these new roles in publishing are potentially in keeping with the values of libraries and the emerging interests of institutions and authors relative to intellectual property ownership and conditions of use. In some cases, there are opportunities to respond to institutional interests regarding the retention of copyright and cost-effective processes and products that can be sustained for the future. Less clear is the extent to which these new roles tap the core expertise of libraries and librarians. Libraries usually bring expertise in information dissemination and use, rather than contribute to the editorial or evaluative aspects of publishing. Consequently, it seems more likely that publishing ventures for libraries will be carried out in partnership with other organizations that have these necessary skills. In this context, library involvement in publishing and content distribution plays off of the fundamental experiences libraries have with information acquisition, access, use, and preservation.

Information Access

Organizing and providing access to information is another classic role of libraries. The twin functions of cataloging and classification have allowed published works to be fixed in a framework of knowledge and to be given multiple access points for retrieval—a combination that has supported general inquiry over time. These functions have brought predictability and a cumulative order to vast amounts of material. As protocols for structuring and sharing bibliographic data were developed for automated systems and networks, libraries

have been able to share these data and build more flexible access systems. In many respects, bibliographic utilities such as OCLC and RLIN and the model of shared cataloging represent early, primitive models of distributed and open approaches to library functions. As distributed forces prevail, models are emerging that no longer rely on central data and capabilities, but rather harness resources through new, distributed mechanisms.

Traditional access activities have been largely undifferentiating and unintrusive; that is, all materials added to libraries have generally had the same descriptive treatment and the functionality or structure of the works themselves have not been materially altered by these processes. As new types of digital content emerge that are structured, include multimedia, and encompass associative links to other resources, it is unlikely that these classic techniques for access can suffice.

Doug Greenberg (2000) has offered a stark characterization of the contrast between traditional library and Internet techniques of access:

> If the key to the library's power is its rigid, counterintuitive arrangement of static information in a comprehensible and hierarchical structure, the key to the Internet's power is its flexible arrangement of dynamic information that permits the human mind literally to jump from one thing to another and back again with no more than stream of consciousness as a guide. It is anybody's guess which of these systems is better adapted to human creativity and curiosity.

The challenge for libraries is to sustain the significant capabilities developed through standards-based bibliographic processes while taking advantage of new access strategies that have been created as a result of new media standards and communication protocols.

Libraries have responded to the challenges of content description for new digital media, extrapolating from existing cataloging practices to develop various metadata schema. These schema have recognized the new types of attributes necessary to represent digital objects and services fully, that is, to describe more than just their content and topic. Administrative and structural metadata, for example, add significant value and capture information about provenance, property rights, and methods of creation or capture, as well as information about the object's structure that can be used by retrieval systems.

Communities and Collaboratories

Metadata developments generally reflect an extension of cataloging practices to new dimensions of content and access. Libraries are seeking to understand how these new access strategies might better serve target user communities. In particular, libraries now analyze how content should be represented to achieve the desired functionality within access systems. Assessing functionality increasingly requires an understanding of *how* content is used, and by whom. For

example, metadata for a collection of plant or animal specimens might incorporate scientific as well as popular names to serve both research investigators and K–12 users. Or a research user may need to map specimen data for geographic analysis, thus requiring the specification and inclusion of spatial references.

As the information environment has become more distributed and more collaborative, how have these forces affected the library's role in facilitating access? Two interesting examples can be found in the OAI and in the functions of metadata harvesting. Although OAI initially focused on e-print archives and new models of scholarly communication, it now is involved in the development and promotion of "interoperability standards that aim to facilitate the efficient dissemination of content . . . independent of both the type of content offered and the economic mechanisms surrounding that content" (Lagoze et al. 2002).

Metadata harvesting techniques address the inability of the popular network search engines to tap the riches of digital libraries and other content that lives within databases and repositories (the so-called deep Web). Metadata harvesting projects involve both "exposing" metadata associated with digital library collections (using specified protocols) and developing harvesting services that can gather these exposed metadata and create access services appropriate for specific uses or user communities. In the early phase of development, both general and specialized services have been proposed; the latter require attention to domain-specific vocabulary or other characteristics associated with specific formats, uses, or users.

As an example of a specialized service, the University of Virginia's proposed American Studies Information Community will draw on harvesting protocols to bring together disparate types of information (text, data, media, images) for a *community*, defined as a group of scholars, students, researchers, librarians, information specialists, and citizens with a common interest in a particular thematic area. The project is being undertaken collaboratively with other institutions and content providers (e.g., Thomas Jefferson Foundation, Virginia Tech University, and the Smithsonian National Museum of American Art). The University of Virginia describes these information communities as "learning and teaching environments in which subject-driven websites are developed around print and digital versions of our collections and the teaching interests of our faculty members . . . Information communities will foster interdisciplinary and collaborative research and publication amongst scholars with common interests."[2]

This access model is interesting because it reflects several trends that are also evident in the broader landscape. The new service will take advantage of a distributed collection model and a range of partners. The descriptive techniques will reflect enhanced attributes appropriate to the subject area and the diverse formats in the distribut-

[2] The University of Virginia's Information Communities are described at http://www.lib.Virginia.edu/dlbackstage/infocomm.html.

ed collections. Analytic tools will be incorporated to add value to the content and to stimulate collaboration. Perhaps most significant, the access system is explicitly designed to serve a *social* role as a catalyst for an interdisciplinary community—a far more intrusive role than is provision of access alone.

A similar model for creating a collaborative environment that mixes content and tools can be found in the construct of a *collaboratory*, having its genesis in the research community. In many respects, collaboratories are a new incarnation of the "invisible college" of the past, in that they focus on creating a communication environment. Collaboratories have been defined as "tool-oriented computing and communication systems to support scientific collaboration" (National Research Council 1993). An often-cited example of a collaboratory, the Space Physics and Aeronomy Research Collaboratory (SPARC), provides an online knowledge environment for atmospheric scientists worldwide. SPARC incorporates the ability to control remote telescopes and instrumentation, to review and collaboratively analyze observational data of atmospheric events, to create and archive vast amounts of research data, and to use tools to manipulate the data.

To the extent that libraries begin to develop access techniques in response to a community and to support the potential development of collaboratories for these communities, we see them assuming a far more integral role within the scholarly arena. In contrast to the approaches to access created in the past, which were focused on published content and largely independent of the less formal aspects of scholarly communication (as in the invisible colleges), this emergent model has the potential to bridge formal and informal communication structures and to develop these structures working closely with the target community of content creators and users. The role of the library moves from manager of scholarly *products* to that of participant in the scholarly communication *process*.

Access and the Semantic Web

A second example of new dimensions of access—an exploration of the emerging *Semantic Web*—is still in a formative stage.

The creator of the World Wide Web, Tim Berners-Lee, is the intellectual force behind the Semantic Web as well. Berners-Lee notes, "the Semantic Web is not a separate Web but an extension of the current one, in which information is given well-defined meaning, better enabling computers and people to work in cooperation" (Berners-Lee 2001). The Semantic Web brings together metadata, a language to structure the data, and a road map (or *ontology*, as known in the artificial intelligence community) that explains relationships between terms. These ingredients for *knowledge representation*—structured content, rich metadata, and a framework or ontology of relationships—allow software agents in computer systems to make inferences and therefore retrieve more intelligently from the vast body of distributed information on the Internet.

Designing the Semantic Web will require a mix of skills, and librarians have the potential to contribute significantly to this effort. One area in which they may become involved is metadata creation, where librarians' expertise in descriptive techniques has obvious relevance. The more complex arena of ontologies—defining relationships between entities such as classes and subclasses or properties and subproperties—is one in which librarians have latent experience in areas such as thesaurus development. Primarily the domain of computer scientists, ontologies and their specification could involve the library community in more multidimensional description, defining and specifying the logic of relationships between metadata elements and objects, e.g., "This document is a digital manifestation of a print object."[3]

In addition to benefiting from rules for representing content and defining relationships, the Semantic Web will benefit from establishing a means of certifying the authenticity and provenance of the content. Otherwise, the diversity of providers and the scarcity of benchmarks to discern quality will seriously limit the Internet as an information retrieval system. How do we know the origin of what we retrieve, whether the descriptive information matches the object, and whether we can believe and trust the metadata? To move the Web from an unstructured and undifferentiated mass of information to a more useful and scaleable information environment, systems of trust and provenance will be essential.[4]

Trust in the Semantic Web can be established through context (e.g., content or metadata from a known group or an authoritative source) or through digital signatures to verify authorship. While the Semantic Web is still in an early stage, one can imagine a scenario in which content selected by or associated with a library access service could establish a context in which the integrity of the information could be validated, in the same way that library acquisition of content in physical collections reflects a selection decision. This possibility, coupled with the proposed methods to validate the source (for example, with digital signatures that certify the content in a similar fashion to publisher imprints), could significantly enhance the library's role in refining retrieval.

Greater intelligence in information systems (for example, through software agents) can make connections between resources, respond to user preferences, and retrieve content on the basis of an array of attributes. If libraries previously were valued for their role in mediating between content and user, what does this new and seamless mediation portend for their future roles? A critical aspect of the library's future may lie in the notion of trust. In the past, a user would make general inferences about a resource on the basis of the fact that it was "associated with a library and its collection" and

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3 See Weinstein and Alloway 1997 for a discussion of ontologies in digital libraries.

4 See Lynch 2001 for further exploration of this topic.

through use of descriptive information provided by the library. By continuing its descriptive role and using new virtual mechanisms to convey context for users, the library can continue to be a signifier that the resource or collection has been examined and formally described, and that a decision has been made about inclusion. This context could be created through well-defined collections of content and services, use of metadata to represent content attributes fully, and development of structures that can validate content and its source.

In the examples cited previously, we see instances where the library's role—in this case, providing access to information—is being reshaped by distributed forces and open models. Here, too, we see the potential for the library's more active engagement and collaboration. Moving beyond simple, descriptive access, libraries will be challenged to understand and fulfill community requirements for robust retrieval and for providing assurance of the integrity and authenticity of content.

User Services

Library user services have traditionally focused on collections support (i.e., helping users identify, retrieve, and use resources) or educational activities to help patrons use their libraries more effectively. These activities have largely been distinct; for example, reference services respond to individuals with specific questions, and instructional programs target classes with general educational needs. The analysis that follows provides examples of more distributed approaches to user services that reflect the development of complex and integrating systems of support.

Evidence of changing user behavior has been documented but is not fully understood. Academic libraries have reported declining in-library attendance and declining use of in-library services such as reference and circulation, although some are experiencing increases in instructional activity (Kyrillidou and Young 2001). Other data indicate a rise in the use of and preference for electronic content (Self and Hiller 2001). Institutional instructional management systems are offering alternative venues for course reserve materials, and the use of traditional course reserve methods has declined. While the profession has yet to analyze fully the relationship among these trends, they suggest increased location-independent use of library and non-library content and heightened interest in acquiring the skills needed to make better use of the myriad systems and services now available on the network. Course-management systems also reflect the increasing desire for services that integrate resources (e.g., syllabi, readings, lecture notes, chat capabilities). These shifts in user behavior and interests prompt the library both to extend traditional services in the networked environment and to consider the broader set of user needs to be addressed in *systems* of user support.

Virtual Reference Systems

The past decade has seen a rise in reference services to support more virtual inquiry. Whereas, initially, the library mainly served remote users who were affiliated with the institution, it eventually came to serve a more global market. Virtual reference methods began with simple communication exchanges, such as reference via e-mail. They now incorporate tools that allow reference librarians to more fully understand the nuance of the reference interview context (e.g., using video technology to capture nonverbal behaviors) or to provide real-time assistance with electronic resources (e.g., through "chat" functions and through technologies to "capture" the user's workstation and guide or "co-browse" networked resources).

Many non-library reference services have blossomed on the Internet. These "expert" or "Ask-a" services may match users and experts, offer specific topic strengths, or incorporate natural language technologies to parse the inquiry and provide a more rapid, automated response. A recent survey of such services suggests that these sites are most effective in response to fact-based inquiries, and that the niche for digital reference services in academic libraries may lie in supporting more in-depth and source-dependent questions (Janes, Hill, and Rolfe 2001). Consequently, users may seek answers to simpler questions on the "greater network" and use library services for more complex inquiries. Given the unlikely coordination between commercial and library services, an interesting set of "design" issues arises. Should libraries develop specialized services, assuming that the Internet will fulfill general needs? Will non-library services of the Internet be of sufficient quality and reliability to satisfy users?

While no data exist to capture the changes in complexity of questions posed to virtual reference services, subjective evidence suggests that these questions are becoming more difficult, and that more queries now require combining content, technology, and instructional assistance (Janes 2002). If users are already beginning to differentiate their sources of support, libraries will have no choice but to determine how best to develop services in the context of what is commonly available on the Internet. Directing users to available fact-based reference sites may be one option, particularly during times of the day when libraries cannot provide human-mediated assistance. The bottom line is that when designing services, libraries must take into account the broader service landscape and user behaviors.

The evolution of electronic reference from single to multi-institutional services creates a more complex framework for virtual assistance. In these models, reference services are collaboratively staffed and mechanisms are developed to profile staff and institutional specializations in systematic and structured ways. In addition, the services often incorporate capabilities for real-time discussion and knowledge databases to store the results of reference transactions for future use. The Collaborative Digital Reference Service coordinated by the Library of Congress, for example, is developing an international infrastructure that is designed to manage inquiries submitted by users worldwide and is staffed by librarians worldwide (Kresh

2000). While the model highlights seamless access to global resources, it also harnesses the human capital of library professionals. Expertise is as important as the network of library collections.

As more functional and intelligent systems are being developed for collection access, the development of reference systems has also involved the specification of standards to enable interoperability among sites and to allow more complex functionality. Evolving protocols and metadata will specify the representation, communication, and archiving of user transactions (Lankes 2001, Butler 2001). The emergence of these standards, along with the move from institutional to collaborative models, is creating a more finely articulated system that supports transactions, communication, and management needs for distributed services.

Viewed in the context of the three developmental stages described earlier, virtual reference services are early in the second stage, beginning to test collaborative approaches. Mechanisms for coordination are still relatively primitive, and the descriptive metadata infrastructure needed to support collaboration is nascent. There are reasons for this rate of development. Developing techniques to describe individual or institutional expertise or to capture complex questions will entail significant effort. The organizational and governance issues are equally challenging. Earlier cooperation among institutions for reference services was done largely through hierarchical systems of referral within state or regional cooperatives (where size of collection and staff determined placement in the hierarchical tiers). The "point-to-point" systems now emerging in virtual, cooperative reference represent a far different model of collaboration—one in which the rules of engagement must be newly specified.

Characteristics of more diffuse activity will become more tangible as virtual reference systems are more widely adopted and integrated seamlessly into the library organization and the instructional and research systems of the academic community. Within library organizations, the next phase of development is likely to show evidence of greater integration between on-site and virtual services, integration of reference and technology expertise, and more finely specified tiers of service and referral (see, for example, Ferguson 2000).

Reference systems may be included as visible and discrete services in online instructional and research environments, or they may be seamlessly interwoven to allow automatic support. For example, a library reference system could be incorporated into a research collaboratory environment as a separately identifiable resource to be selected when help is needed. Alternatively, mechanisms may be developed within access systems to prompt users to seek reference assistance when they are having problems (e.g., after several unsuccessful searches or inquiries). These prompts could be mediated by librarians or addressed by automated "Help" files tied to the specific problem.

Research on user failure in libraries has documented areas where users frequently experience problems; for example, the library may

not own the desired item, users may ineffectively use the catalog or other access services, or a desired item may not be found on the shelf. Often, the user does not interpret these problems as "failures," and they do not necessarily result in a request for assistance. In the electronic environment, there is an opportunity to build in mechanisms to capture problematic interactions between content and user. This opportunity to provide point-of-problem guidance, along with the ability to collect detailed data on use, may allow the library to be a presence in an area where it previously was unable to provide support. A key challenge will be striking the right balance between proactive and reactive assistance.

While the traditional notion of library services focuses on user-initiated requests within a library facility, the more diffuse constructs bring reference and technical expertise to a wide range of contexts, within both physical libraries and online environments. Query-based services are expanded and enhanced with more context-sensitive or resource-specific support. Ultimately, the library's presence becomes more pervasive and its services more fully integrated into the processes of learning and research.

Information Literacy

Instruction—helping people use library resources more effectively through directed and structured educational activities—is another core service that libraries have traditionally offered users. (Such support has been geared typically, although not exclusively, to undergraduate students.) In the digital age, putting bounds around "library resources" has become a daunting task. Moreover, the instructional needs of users have changed dramatically as new methods for teaching and learning have emerged.

What has changed in the learning environment? While the answer to this question varies by institution and by discipline, certain trends are evident. In the 1990s, higher education was influenced by two forces that, though unrelated in principle, ultimately became intertwined in reshaping the educational experience. First, technologies emerged that enabled distance-independent, asynchronous venues for instruction. These technologies were adopted not only for use in distance education programs but also for more generalized applications on campus. The second phenomenon was the growing pressure to rethink the academy's approaches to teaching and learning, particularly with respect to the undergraduate community. These two forces have created a volatile environment, but one that offers tremendous opportunities for libraries.

Several recent reports chronicle the changing philosophies of the instructional experience. In 1998, a National Governors' Association poll found that the facilitation of life-long learning and the development of more collaborative and applied opportunities for learning were among the governors' top priorities in higher education. The same year, the Boyer Commission report, *Reinventing Undergraduate Education*, challenged universities to revitalize undergraduate curricula and to create a baccalaureate experience that draws on and is in-

tegrated with the institution's overall programs and mission (Boyer Commission 1998). More recently, the Pew Charitable Trust's National Survey of Student Engagement (Kuh 2001) and the Kellogg Commission report on the future of state and land-grant universities (Kellogg 2001) described the need for stronger links between discovery and learning through opportunities for student engagement in active learning and in community issues.

These analyses have prompted institutions of higher education to give greater priority to undergraduate education and to rethink the fundamentals of the undergraduate experience. University of Illinois Chancellor Nancy Cantor has described these fundamentals as a trinity of needs, saying that "students must be prepared to embrace technology, to work collaboratively, and to interact with a diverse set of people and ideas" (Cantor 2000).

There are countless examples of institutional responses to the themes highlighted in these analyses. At a general level, there are alternatives to lecture-based and classroom-intense methods. Projects, often group based, are increasingly part of the curriculum. Opportunities for engagement with community and social issues are on the rise. Discovery-based learning models are in evidence. Many institutions have launched initiatives to integrate these developments. For example, the University of Maryland's Gemstone program fosters multidisciplinary community experiences with active engagement in real-life problems. Teamwork and technology are critical components. The James M. Johnston Center for Undergraduate Excellence at the University of North Carolina has created a place for collaborative inquiry, teleconferencing with remote sites, and a laboratory for innovation in teaching and learning. The common themes are, as Cantor (2000) details, technology, collaboration, and diversity (in the broadest sense, as reflected in the intellectual diversity of interdisciplinary programs).

How do these changing values and priorities in the educational experience affect the library and its roles in support of teaching and learning? Do traditional approaches of bibliographic instruction still resonate? While information sources and methods for finding information are still a useful component of library instruction, a broader construct of *information literacy* has emerged as a framework for effective information inquiry. This framework can provide a repertoire of essential skills that support students in new learning contexts.

What skills are necessary for information inquiry in the digital age? Is it possible to separate content skills from the tools that facilitate access? Has the basic function of inquiry changed as new analytic capabilities become available? A number of perspectives have been brought to bear in understanding these new dimensions of learning and associated skills.[5] These perspectives generally articulate two

[5] The Association of College and Research Libraries' information literacy standards focus on locating, evaluating, and using information effectively. The National Academy of Sciences Commission on Information Technology Fluency (National Academy of Sciences 1999) advocates a focus on practical skills and basic concepts, as well as on higher-order intellectual capabilities that "foster abstract thinking about information and its manipulation." John Sealy Brown has suggested a new framework for literacy that includes the abilities to navigate complex information environments, engage in discovery-based learning, exercise judgment in differentiating the utility of information, and learn by action (Brown 2000).

dimensions of literacy. One dimension reflects the need for skills to exploit technology to use information effectively. The second dimension is the need for a conceptual understanding of information and knowledge processes. In reality, a marriage of these fluencies is needed. The traditional functions of identifying, finding, and evaluating information are joined with more conceptual notions of inquiry, information analysis, and use. These information skills are now interwoven with technology skills.

Bruce (1997) has posed one of the more interesting integrated frameworks for information literacy. It features a series of maturational levels that begin with a basic capability with technology and move the individual to an increasingly more sophisticated appreciation of information sources, information use and problem solving, and information management. Building an understanding of the characteristics of information is also important to literacy; issues of intellectual property, authenticity, and provenance are critical in a networked environment where the traditional signifiers of quality are absent. Libraries are then challenged to articulate a conceptual framework for instruction that integrates these concepts and skills in support of student learning.

Two different models of information literacy programs illustrate how these practical and conceptual dimensions are integrated. The University of Texas's Texas Information Literacy Tutorial (TILT) program has developed a set of online modules that teach research skills. While designed to develop technical and information resource skills, TILT also seeks to build an understanding of information issues relating to censorship, privacy, commerce, global communities, and legal and policy constructs. TILT uses discovery-based and interactive approaches to learning. A particularly interesting aspect of TILT is its open source agreement for the underlying software, which will permit collaborative development of future enhancements.[6]

The University of Washington's UWired program is a collaborative undertaking of the libraries, campus technology offices, and educational program offices. It targets both faculty and students, and has developed tools and content for these distinct audiences. Like TILT, the program employs active learning techniques in its tutorials and also develops the learner's technical skills. UWired includes an outreach dimension as well, designing programs carried out within "commons" facilities in libraries, faculty symposia, and workshops; for-credit seminars; ties with freshman curricula; and programs with the community, the school system, and international partners. This program has clearly served as a catalyst for creating partnerships and for extending the library's reach beyond the campus-based curriculum.

TILT and UWired offer compelling examples of successful collaboration and the use of new pedagogical and technological methods to instruct both students and faculty. Both approaches represent a

[6] Within a year of TILT's release in 2001, some 60 institutions had licensed this software.

synthesis of traditional librarian experience and increasing knowledge of instructional design, the architecture of networked information within a discipline, and relevant tools for analysis and access. Diffuse characteristics are notable as the programs reach into the curriculum and are adopted as integral components of the educational experience. The diffusion continues as opportunities are made available to share the development with others and as the capabilities are leveraged in service to the institution's outreach agenda (e.g., Washington's international programs).

Organizational Models

As libraries have become more distributed and more collaborative on their campuses, some interesting organizational models have emerged that involve librarians more directly in academic program development. Several of these programs have characteristics that recall the clinical librarian models developed in the last several decades.[7] For example, Stanford's Academic Technology Specialist Program has created discipline-specific appointments that emphasize providing assistance onsite within academic departments (Keller 1997). Combining subject and technology expertise, these professionals are vital links between academic programs and central curatorial or computing staff resources. The University of Michigan's recently launched Field Librarian program similarly joins subject knowledge, technology, and library expertise. The appointments are developed collaboratively with academic programs, and the field librarians are physically located within the academic department to facilitate their direct engagement in faculty teaching and research.

Library as Place

The library has a continued role as place. In the past, this function has been characterized as a location for individuals and information to interact—a place for users to tap collections or for library staff to bring users and information together. The physicality of libraries and their collections is an often-cited value. The ability to browse and experience the gestalt of an array of resources has been a time-honored technique for inquiry, and the physical experience of books, maps, or manuscripts is important for many. Library facilities also serve a social function, providing a common ground for users to interact or a neutral site for individuals from different disciplines to come together.

The changes in library roles discussed thus far have obvious consequences for library facilities. Once the physical centerpiece of a campus with large, central collections, library resources are now more distributed and library users more nomadic. The challenge is twofold: reconceiving library buildings to reflect changing user be-

[7] Clinical librarian programs were initiated in the 1970s as an interface between practitioner and the medical literature (Smith undated). These programs typically bring the librarian into the practitioner environment—e.g., in physician rounds—and provide both research literature in response to presenting cases as well as real-time instruction.

havior and needs, and developing the library's network presence as a virtual place of comparable value.

Libraries face a paradox with respect to facilities and their use. Data from the Association of Research Libraries and individual institutional analyses show a decline in building traffic. Yet some campuses report increased interest in 24-hour availability of library facilities. The University of Washington's ongoing survey of users reflects these trends, with the most recent responses indicating decreased facility use by faculty and graduate students, and a modest increase in use reported by undergraduates (Self and Hiller 2001). Washington has a 24-hour undergraduate library facility and well-established computer facilities within libraries, which the survey data indicate are heavily used.

While most libraries have incorporated computing capabilities, the characteristics of new computer facilities are noteworthy. A recently launched service of the Coalition for Networked Information and Dartmouth College Library, *Collaborative Facilities,* compiles and disseminates information about new types of campus facilities that are being developed within libraries, many of which receive collaborative support from campus organizations. Several of the projects focus on creating new types of instructional services and integrating digital media and computer resources. These new uses of facilities are consistent with the changes in the curriculum and research methods noted earlier. While still serving as a place for collections, library facilities increasingly serve as environments for learning and collaboration.

As geography loses its primacy as a basis for organizing libraries and as the phenomenal growth of digital content continues, libraries are challenged to identify ways to make their virtual roles visible and tangible to their campus communities. Too often, users do not know where responsibility lies for networked content and services; information and services are simply *there,* and presumably free. Is there a new sense of *place* in a digital context?

As described, there are emergent roles for libraries in a digital context that are extrapolations of existing functions. Here, the challenge may be to ensure awareness of these now-virtual services and the library's responsibility for them. A more complex undertaking is establishing roles that do not easily build on existing library functions. While marketing is no less an issue, a fundamental hurdle is the demonstration of library expertise through sufficient investment to make visible its role in innovation.

While the nature of library facilities will change, the notion of *library as place* remains important in both physical and virtual contexts. Increasingly, this sense of place serves strategically to further the development of new roles.

Realizing Diffuse Roles for Libraries

> Libraries must now turn their attention to defining their missions and activities in relationship to what is transforming them: the information technology revolution in teaching, learning, and research. (Lynch 2000)

The transformation of libraries to fulfill more diffuse roles within the academy reflects a shift in perspective both for the library and for the other stakeholders in this arena. There are significant challenges to be overcome, not the least of which is the pace of technology development. The volatility of technology contrasts with the glacial speed of change within higher education regarding core values and structure. How can libraries claim these new roles when they face pressures both to innovate and to steer a more traditional course?

An additional challenge lies in the conundrum of market strategy. Should a library assess demand for these new roles and secure funding support before it moves in new directions? Or should it forge ahead, create demand, and hope that funding will follow? Both courses of action have risks. Yet evidence suggests the competition both within and outside the university requires that the library lay claim to areas where its core expertise is relevant, lest it be marginalized.

Libraries have thus far evolved fairly predictably in developing a digital presence and digital capabilities, particularly with respect to technology infrastructure and expertise. As Greenstein and Thorin (2002) have noted, there is an initial phase wherein an individual library's activity is largely project-based. Involvement of others outside the organization is minimal and resource commitments are typically nonrecurring. In this stage, libraries experiment with and exploit distributed technology capabilities. In the next stage, the "adolescent" library has far more interest in its peers. Collaborative activity within the library community emerges, and outreach to others within the campus environment becomes more prevalent. Often in this phase, groundwork is laid for more stable production capabilities for content, access, and services. Libraries add staff and develop new work processes. Resources are reallocated, but often the activities are still viewed as separate from the mainstream.

Nearing a more mature phase of digital capacity, the library organization is better positioned with secure infrastructure and leadership to collaborate with other libraries and other stakeholders. Workflow becomes more integrated, and investment is consistent with mission; i.e., permanent sources of support and organizational structures are put in place. Relationships with other stakeholders are often more "open," that is, characterized by leveraging each other's expertise and strengths to the benefit of a programmatic goal.

While it is possible that a large infusion of funds might hasten this developmental cycle (particularly as it relates to building technology infrastructure), the organizational development necessary to integrate complementary expertise and adjust goals is likely to come only with experience and time. Consequently, these evolutionary

stages—moving from distributed, to open, to diffuse roles—may be a requirement, a rite of passage.

Do libraries have a choice about future directions? Residential campuses are unlikely to disappear, and instructional and research programs are unlikely to abandon their interests in traditional libraries for the foreseeable future. Yet the evidence of changes in institutional priorities (e.g., with respect to outreach, new markets, and intellectual property) and in individual user behavior (with respect to expectations and needs) suggests that caution will be shortsighted.

The transformations under way in teaching, learning, and research will require a far different conception of the library. At a minimum, structures for the acquisition and description of digital content need to be in place and services developed to respond to a more nomadic and virtual clientele. These minimal requirements, however, merely extrapolate existing roles for collections, access, and user support. Seizing opportunities for more diffuse roles will require investment in both tangible components and in intangible elements such as leadership and organizational development.

Tangible Investments

Certain investments must be made if the library is to emerge as a player in the changing environment. Participation in new learning communities, in new ventures for knowledge management or dissemination, or in service to new markets requires investment in technology infrastructure and expertise in the handling of digital resources and tools.

In developing digital library infrastructure, there is a tendency to assume that each institution must develop a full complement of capabilities. This assumption is attractive because hands-on experience does provide invaluable developmental opportunities for staff. However, it is also becoming clear that institutions may have difficulty in sustaining the ongoing development of the local infrastructure. Further, an isolationist approach may not allow libraries to leverage institutional strengths or the benefits of a high volume of activity. Consequently, collaborative development of tools, services, and capabilities will be far more common in the future. Evidence of these trends already exists, e.g., the Open Source software movement, cooperative reference services, and university-based initiatives to share tools and methods such as publishing resources of the Berkeley Electronic Press (bepress), Michigan's Digital Library Extension Service, and the Texas TILT program.

Competition has become intense for qualified professionals who can manage and develop new library roles. While many library or information-science graduate programs have revamped their curricula, it is impractical to assume that the needed leadership can come exclusively from newly minted professionals. Investment in professional development and participation in collaborative opportunities that can help advance organizational development are essential. Insights are often born of exposure to new ideas and of the freedom to

explore. Consequently, professional development models that include support for experimentation, experiential methods of stimulating creative thinking, and focused interaction with colleagues from other institutions are particularly useful. New contexts for these interinstitutional interactions are also evident in organizations such as the Coalition for Networked Information and the Digital Library Federation, which provide venues for peer-to-peer dialogue and focused attention to common issues.

Technological expertise is in demand, but it is equally important that the profession attract individuals with agility in applying or exploiting new technologies in the service of new roles. It is essential that these individuals have a deep understanding of the communication structures and processes within disciplines. Such capabilities, while informed by technology, reflect development beyond task-specific skills such as cataloging to a contextual knowledge of scholarly processes and user needs. The challenge is to assemble the constellation of technology, subject, and application expertise and to facilitate the necessary collaboration between functional divisions of the library.

A recent survey conducted by the Digital Library Federation (Greenstein and Thorin 2002) captured structural and financial data about university and library development of digital library programs. While offering descriptive information from only a handful of institutions, all of which have more mature programs, the survey results reflect organizational models that are highly collaborative. Partnerships were found with information technology units and, in some cases, schools of library or information science or research institutes. In such models, managing relationships is essential to ensuring program stability. The data also suggest that the library's assumption of new and expanded roles actually *attracted* new funding—an affirmation that in some cases action must precede explicit institutional support.

Intangible Investments

Infrastructure, expertise, and tools, while enabling, cannot forge a new agenda for the library. Leadership must be present to leverage the library's full range of assets. The examples cited throughout this analysis show how the library adds value through its expertise and its resources. Nonetheless, the prevailing forces also create an environment in which the library's efforts to support virtual collections and services can make the library less visible. An important aspect of leadership in the digital age will be the ability to articulate these new roles in a way that makes the library's contributions substantive and visible.

Seizing opportunities and articulating the library's potential, in turn, require organizational agility, i.e., the flexibility of budget and human capital that allows responsiveness and, when needed, redirection of activity.

In the new environment, a culture of collaboration will be essential if the library is to fulfill its potential for providing services and

collections. Collaboration will mean not only embarking on successful joint projects, but also managing campus and external relationships to ensure that the library is present at the table for relevant institutional dialogue and decision making.

The development of diffuse libraries will entail an understanding and appreciation of the shifts under way in all sectors of the academy, investment in infrastructure, and an organizational culture that nurtures and catalyzes relationships. *Distributed, open, diffuse*—these characteristics describe the stages that mark the library's evolution. Ultimately, the transformed, diffuse library will embody an intimacy of purpose and a full engagement both with institutional goals and with the practical conduct of learning, teaching, and research.

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